U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—BULLETIN No. 20.

MILTON WHITNEY, Chief.

GROWING SUMATRA TOBACCO UNDER SHADE

IN THE

CONNECTICUT VALLEY.

BY

MILTON WHITNEY.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1902.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., March 8, 1902.

SIR: I have the honor to transmit herewith a detailed statement relating to the experiments in growing Sumatra tobacco under shade in the Connecticut Valley during the past season under the direction of the Bureau of Soils, Department of Agriculture, which I recommend for publication as Bulletin No. 20 of this Bureau. The experiments were conducted under the immediate supervision of Mr. M. L. Floyd, tobacco expert of the Bureau of Soils, aided by a corps of assistants cooperating with individual planters.

A widespread interest has been taken in this work, and a general desire has been expressed to try to introduce this new industry in new areas in the different States. As will be gathered from this bulletin, the growing of Sumatra tobacco under shade involves a considerable outlay of time and money, and in my judgment it would be unwise to attempt a costly experiment of this character in areas where the soil survey has not indicated at least a reasonable chance of success. With the exception of a small area in Florida and southern Georgia, where this type of tobacco was originally introduced and is still successfully grown, and of a narrow area of Donegal gravelly loam along the Susquehanna River in Pennsylvania, there are no other areas, so far as at present known, where this type of tobacco can be successfully grown, unless it may be on some of the soils of the tobacco districts of New York and Wisconsin; but as the soil survey has not been extended to these places nothing definite can be said as to the possibility of raising Sumatra tobacco on such areas.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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GROWING SUMATRA TOBACCO UNDER SHADE IN THE CONNECTICUT VALLEY.

INTRODUCTION.

Soon after the organization of the Division of Soils in the United States Department of Agriculture, in 1891, an investigation of the physical properties and composition of the tobacco soils was begun in the principal tobacco districts of the United States. In 1896 a bulletin was published entitled "Texture of Some Important Soil Formations," in which the principal soils of the Connecticut Valley were briefly described, and the following statement was made:

> The characteristic tobacco of the Connecticut Valley is grown upon light sandy soil bordering on the Connecticut River, and having the same general texture as the early truck soils of the Atlantic coast. The tobacco produced upon these light soils has a light color and a moderately thin-textured leaf with small ribs and veins. It resembles the Sumatra type, with which it has to compete.
>
> The percentage of clay in the soil has a marked effect upon the color and texture of the wrappers. As a rule soils containing the least amount of clay produce the lightest and finest textured wrappers. The yield per acre is less than on the heavier soils, but the crop brings a better price per pound.

In the same bulletin some samples of soil from the best known tobacco districts of Sumatra were described, and it was stated that the texture of these soils was not very different from the texture of the soils of the Connecticut Valley, and that the chief difference lay in the larger amount of organic matter found in the island soils.

In 1898 a bulletin was published entitled "Tobacco Soils of the United States," in which the climatic conditions of the important tobacco districts in Sumatra, Cuba, Florida, Connecticut, and Pennsylvania were compared. The statement was there made that the meteorological records of the period in which the tobacco was grown in these different localities did not seem to explain the remarkable differences in the character of the leaf.

In 1899 Congress authorized a soil survey of the tobacco districts of the United States, and in the summer of that year a survey was made of about 400 square miles in the Connecticut Valley. This area extended from South Glastonbury, Conn., to South Hadley, Mass.

In the report describing the results of this survey, published in Report No. 64 of the Department of Agriculture, entitled "Field Operations of the Division of Soils, 1899," the following statements are made:

The characteristics of a good wrapper leaf, as described by Mr. Floyd, are that it should have but little body, little aroma or flavor, should be very pliable so that it will stretch and cover well, and have good texture, grain, and style, in order that it will appear well on the cigar. The leaves must be of a uniform color, and not too large, the 14 to 16 inch leaves being the most desirable sizes.

While the Connecticut Havana has long been recognized by the trade as the most desirable domestic tobacco for wrapper purposes, yet the difference in price shows at once how the tobacco is regarded by manufacturers in comparison with the imported leaf. The Connecticut tobacco is worth, on an average, about 18 or 20 cents per pound; the Sumatra tobacco, imported exclusively for wrapper purposes, pays a duty of $1.85 per pound and sells on the market for from $2.50 to $3 per pound, duty paid. The Connecticut leaf is too large for an ideal wrapper, being often from 26 to 30 inches in length; the veins are very large, and only the tip of the leaf is suitable for high-priced cigars. Either on account of the physiology of the leaf or in the method of case sweating, the desirable grain, color, and style are confined to the tip of the leaf, the lower half being glossy and very undesirable for wrapper purposes. This makes a great deal of waste, which can only be marketed in foreign countries at an exceedingly low price. Lastly, the tobacco is more highly flavored than is desirable for wrapper purposes and frequently masks the desirable qualities of the filler used in the cigar. These defects, as already stated, are to be made the subject of an exhaustive inquiry in the Division of Soils.

"One of the objections urged by the manufacturers against the Connecticut tobacco—a fact which certainly largely reduces the price paid for the crop—is the unevenness of color and the poor grading as to color, length, and quality of leaf. In order to maintain a uniform brand of cigars, a manufacturer is forced to purchase a large amount of Connecticut leaf from which to select. Furthermore, on account of the difference in length and in texture of the leaves, there is considerable waste, which is difficult to estimate. It is hard to plan, therefore, for an economical use of the product when a purchase is made. This is not the case with the carefully sorted Sumatra.

* * * * * * * *

"The one great trouble with the Connecticut tobacco is that it does not conform to the present requirements of the cigar trade. The leaves are too large, the veins are too large, the base of the leaf is too glossy and lacks texture and style, while the color of the leaf is far from uniform. An attempt is soon to be made to secure a radical change in the type of the leaf by close planting, allowing many more leaves to the stalk, by very rapid growth, by shading, and possibly by irrigation. These experiments with the Connecticut tobacco will be undertaken in the hope of producing a leaf approaching more nearly the Sumatra type of wrappers, this type being generally accepted in this country as the standard for cigar wrappers.

"With the intensive cultivation that this will require, it is quite possible that these Windsor sands may be looked to for the finest wrapper leaf. I am of the opinion that even with the present style of leaf it would pay to irrigate these lands where this could be done easily and cheaply, in order to secure a crop four times out of five at least, where now it is only possible to obtain one or two crops out of five.

"The Hartford loam is decidedly a safer soil and can be relied upon to produce a fairly good crop of the Havana seed-leaf variety each year.

* * * * * * *

"Such questions as these will form the basis of an extensive line of investigations already outlined, requiring several years of systematic work."

In December, 1899, Mr. M. L. Floyd, the Tobacco Expert of the Department, was sent to Connecticut to cooperate with the experiment station at New Haven in the fermentation of the crop which had been grown in the experimental field under the direction of Dr. E. H. Jenkins, and to see if a more uniform color and more desirable quality could be developed from the present style of Connecticut leaf by the bulk method of fermentation, which had long been used in Florida, Cuba, and Sumatra. The crop thus fermented showed some improvement over the average crop of the State, but not sufficient to make any notable difference in the commercial value of the leaf. Accordingly, in the spring of 1900, arrangements were made through cooperation with the Connecticut Experiment Station to grow a small area under cheese-cloth shade. A framework was erected over about one-third of an acre and covered with ordinary cheese cloth, which was sewed together so as to cover the entire structure on the top and sides. About half of this area, or about one-sixth of an acre, was planted with the ordinary Connecticut Havana seed, and the other half with Florida-grown Sumatra. On the fermentation of this tobacco it was at once seen that the Connecticut Havana seed leaf was much finer than that grown outside, but that the ribs and veins were still too large for the most economical commercial use. The Sumatra leaf, however, was a vast improvement over anything that had been grown in the State, and while it was not a perfect substitute for the imported Sumatra leaf, it gave promise of more desirable results if the experiments were continued on a larger scale and under somewhat different methods. In both cases the plants were put close together (12 inches apart) in the row, and it was found that the plants that were not topped were decidedly better than those that were topped. The leaves were thinner, more elastic, and the color more uniform.

The use of the shade was not new, as it had been used in Florida with great success, and the seed which gave the most valuable leaf was the Florida-grown Sumatra seed. Nevertheless, there was a good deal of adverse criticism in the Connecticut Valley of the idea of attempting to change the character of the leaf, as the Connecticut Havana seed had been grown there for upwards of a hundred years. The culture and treatment were believed to be thoroughly understood by the growers, by whom it was argued that even if the fine Sumatra leaf could be produced the high cost of labor would prevent the expensive work of grading and assorting essential to competition with the imported Sumatra product. In spite of these objections, however, and in view of the fact that there was such an enormous difference between the commercial value of the Connecticut leaf and the imported Sumatra leaf, the Department decided to continue the investigations and to see if the leaf could be commercially grown under the conditions prevailing in the Connecticut Valley. As it was considered

desirable to make this demonstration on a commercial scale, in the spring of 1901 arrangements were made with a number of growers by which about 41 acres of shade were erected, and the crops were cultivated under the direction of Mr. Floyd and a number of assistants. The arrangements provided that the farmers were to pay the entire cost of the erection of the shade, cultivation of the crop, and the fermentation, grading, and sorting of the leaf; that the Department should furnish the seed, and should control in every way the cultivation, fermentation, grading, sorting, packing, and actual selling of the product, the understanding being that the Department would receive no financial benefits from the sale, but should simply have the right to offer the crop for sale so as to determine the value placed upon it by the tobacco dealers and manufacturers.

There were thirteen growers who cooperated in this undertaking, located in various parts of the Connecticut Valley, both in Connecticut and Massachusetts.

The names and addresses of these growers follow: H. Woodford, Avon, Conn.; C. O. Gates, Pine Meadow, Conn.; James Stewart, Pine Meadow, Conn.; E. C. Hills, Southwick, Mass.; H. L. Miller, Southwick, Mass.; H. K. Wright, Mapleton, Conn.; Clark Brothers, Poquonock, Conn.; William Hayes, Tariffville, Conn.; August Pouleur, Windsor, Conn.; L. M. Case, Barkhamsted, Conn.; W. S. Pinney, Suffield, Conn.; R. H. Reed, Tariffville, Conn.; Ariel Mitchelson, Tariffville, Conn.

It is estimated that the growers invested from $20,000 to $25,000 in this work, including the erection of the shade, cultivation, handling, and baling of the crops, while the Department spent about $10,000 for the supervision of the work.

At the time this bulletin is written the work has not been quite finished, as one lot of tobacco was somewhat delayed, and the final results can not be given. On account of the great interest in the work, however, and the number of people who are going into the raising of shade-covered tobacco during the present season, the publication is justified even before the crop is sold, as the growers want to know the cost of producing the crop, the yield that has been obtained, and the proportion of wrapper leaf of different grades that has been produced. It is expected that the crop will be all packed and ready for market about the 1st of May, when it is to be sold at auction in New York, and the prices which it brings will be a matter of public information in the daily press. By invitation of the Secretary of Agriculture, a committee of prominent tobacco brokers of New York and Philadelphia have agreed to advise the Department in regard to the sale, and at the special request of the Connecticut growers the Hon. E. Stevens Henry, Congressman from the First district of Connecticut, who has taken a very active interest in these investigations

EIGHT-ACRE FIELD COVERED WITH TENT CLOTH ON MITCHELSON FARM AT TARIFFVILLE, CONN.

from the start, and who has done much to insure the success of the undertaking, has been made chairman of the committee. The other members are M. E. Flaherty, New York; Steven G. Ruth, New York; S. M. Seymour, New York; Capt. Darius Ferry, New York; Herman G. Vetterlein, Philadelphia; and James Ertheiler, New York.

In the progress of the work many suggestions have been made, and much experience has been gained. While the results have been exceedingly satisfactory and the product is looked upon with the utmost favor by the tobacco dealers and brokers who have examined it, it is not to be supposed that improvements can not be made in the future. It is well known by all tobacco growers that the different kinds of soils require different treatment, and different seasons give their several problems which have to be met and worked out in a practical way. There will naturally be many ideas developed as to the improvements that can be made; some will think the leaves are rather too thin, and that the plants should have been topped, and others that the plants should have been crowded a little more, or given a little more space in the rows, or that the picking should have been a little earlier or a little later to get the best results. Such differences of opinion are likely to arise and it will take years to develop the best methods. In the experiments this year a number of soils of different texture were purposely tried, to study the influence of the soil on the character of the leaf. The season happened to be an exceedingly dry one during the early period of growth, and this was followed by an unusually wet spell, as there were about 8 inches of rain during the month of August. A season with a normal rainfall or lower temperature than prevailed during the greater part of this year would give different results, and would require different treatments in various stages of the work. It was planned to make very complete records of the moisture conditions of the various soils and to study carefully the influence of the shade upon the temperature and humidity of the air; but the experiment was so large, the fields were so scattered, and the labor needed so much constant instruction and supervision, that it was found that all of the energies of the Department's experts had to be given to the actual field operations. The result is that many of the observations that were to have been made were of necessity omitted and the data obtained is of too fragmentary nature to give a satisfactory idea of the conditions of soil and climate which it would be desirable to have. It was realized, however, that the main point was to see if the tobacco could be successfully grown and produced upon an economical basis, and that these supplementary observations could be carried on at some future time. Now that it has been proved that the tobacco can be grown, these other observations will undoubtedly be made, and the production of the leaf

and the relation of the soils to the character of the leaf and to the necessities of cultivation and irrigation will be further studied and will unquestionably be beneficial.

PREPARATION OF THE SEED BED.

No special plan was adopted in the preparation of the seed beds at the various plantations, the methods in common use being accepted; but suggestions were obtained of the best method of preparing the beds which may be of interest in this connection. The Sumatra seed requires an unusually high temperature for germination. At the ordinary temperature of the soil in the spring the germination of the seed is extremely slow and very uncertain. It is very important that in the preparation of the seed bed an ample supply of seed should be sown and provision made for a succession of plants, so that when the planting season comes the supply of plants suitable for transplanting will be ample for the purpose and the supply will be maintained throughout the period in which the planting is to be done. The use of the mechanical planters makes it possible to set the plants regardless of dry seasons, but the actual planting of a number of acres takes considerable time, and the plants must be available in the right condition as the work of transplanting proceeds.

In the preparation of the seed bed work should begin the preceding fall, when the ground should be well plowed or spaded, and divided into beds about 6 feet wide with any desired length, surrounded by boards 2 inches thick and 12 inches wide, set 2 or 3 inches in the ground. These beds should be highly fertilized with cotton-seed meal and stable manure well spaded in to a depth of 6 or 8 inches, and the whole covered with leaves, manure, or trash to keep out the frosts during the winter season. About the 1st of April this top dressing should be taken off, the bed again spaded, and the soil well pulverized, after which another application of cotton-seed meal should be given, which should be raked in and the surface made smooth and loose. About five days before the time of sowing, the seed should be put to sprout in apple-tree punk or similar material, made soft with warm water. This should be put in a fruit jar or other suitable receptacle, and kept in a warm room at a temperature between 75° and 80°. It will be noticed that the seed do not sprout uniformly, but it is well to wait until nearly all of the seed have germinated. The seeds so sprouted should be mixed with bran, cotton-seed meal, or well-sifted ashes, and sown at the rate of about 2 tablespoonfuls of the seed to 100 square yards. It is well to mix about an equal proportion of sprouted seeds and of fresh seeds with the ashes or other material before sowing, as the plants from the sprouted seeds will be ready for transplanting when the plants from the unsprouted seeds are just coming up. This will insure a long period in which transplanting can

FIG. 1.—PORTION OF EIGHT-ACRE FIELD, SHOWING METHOD OF FASTENING CLOTH.

FIG. 2.—END OF FIELD, SHOWING METHOD OF CONSTRUCTION AT THE CORNERS.

be carried on. After the seeds are sown the ground should be rolled with a heavy roller, and if the soil is at all dry the beds should be watered, and they should be kept continuously moist, but not wet, until the plants are set out.

On a commercial scale a little over half an ounce of seed is used for an acre of land, or a pound of seed to 25 acres. This insures an abundance of plants, and in favorable seasons there will be more than enough, but it is poor economy to have scant seed beds and have to wait for plants. After the plants are sown they should be covered either with glass or cloth. Mr. Mitchelson had a very desirable arrangement for his plant beds, which were constructed in the following way: The beds were surrounded by boards, as described before, and pipes were run along the inside of the boards and connected with a small boiler. In the fall the ground was made exceedingly rich, and the surface was made quite fine and smooth, and over this was spread a piece of cloth. The bed was then covered to a depth of 6 or 8 inches with manure, leaves, and trash, both to enrich the soil through the percolation of rain and to protect the soil from frosts. Just before the seed was sown the cloth was pulled off, removing the surface covering of manure and leaves and leaving the surface of the ground in an unfrozen and moist condition. The beds were then heated by steam and maintained at the proper temperature for quick germination and for continuous growth. Ordinarily it requires from sixty to seventy days for the seed to germinate and grow to sufficient size for transplanting. By forcing them a little by the use of steam in pipes laid beneath the surface of the ground or along the inside of the boards the same objects can be attained in from thirty to forty days. This practice is frequently used by truck farmers in producing sweet potato plants and other plants of a similar nature which are to be set out in the early spring. Instead of steam pipes flues are used by the truck farmers, the products of combustion being led under the surface of the ground to a chimney at the far end of the bed. In this case the slope of the flue tends to equalize the temperature of the bed at the two ends and in the middle, the flue being farther below the surface near the furnace.

If the land where the seed bed is to be made is foul with weeds or grass, it is desirable to burn it off by building fires over it, or by paring and burning, as is frequently practiced even on a large scale in English gardens. The beds should be watered whenever it is necessary, but they must not be too wet, as there is trouble from damping off.

SELECTION OF THE LAND.

As was pointed out in the report of the soil survey of the Connecticut Valley, the Hartford sandy loam is believed to be the safest and on the whole the most desirable soil for the Sumatra tobacco. This

is a very light sand or sandy loam, identical with the early truck soils of the Atlantic coast. It is admirably adapted to garden vegetables, but is not suited to general farm crops. It has been pointed out in previous publications of this Department that the Windsor sand, or the so-called "plains" of the Connecticut Valley, will probably produce the finer quality of leaf, provided the seasons are just right or if irrigation is practicable. It is thought that possibly the use of the shade will do much to obviate the necessity of irrigation on these light lands, but it is believed that irrigation, where practicable, would be a profitable investment to insure the crop against injury in the event of drought. The Windsor sand is a coarse sand, with a considerable amount of very fine gravel. In the production of these fine grades of cigar wrapper everything depends upon the quick and continuous growth of the plant. Every moment that a plant suffers for lack of moisture tends to thicken the leaf and to make it less elastic. There are numbers of small streams in the Connecticut Valley which could be used for purposes of irrigation, and it is believed that when the industry becomes well established this method will be used to a considerable extent.

The Enfield sandy loam shown on the soil map of the Connecticut Valley is probably as well adapted to the growth of the Sumatra tobacco as the Hartford sandy loam. It differs from the Hartford sandy loam in having a clay subsoil within an average of 2 feet from the surface. There is comparatively little of this soil in the valley. At the time the soil survey was made it was not thought that the Triassic stony loam would be so desirable for this fine-textured leaf, but the results during the past season have indicated that the crop on this type was about as fine as that grown upon the Hartford sandy loam. It was not tried, however, upon typical Triassic stony loam. This has been, however, an unusual season, and the crops grown on the several types of soils have not shown the differences which it was expected would be found. It may be, of course, that these soils will all have nearly the same value, but for the present it is recommended that the opinion given in the report of the soil survey be adhered to, viz, that the safest soil is the Hartford sandy loam, and possibly the Enfield sandy loam, while the Windsor sand will make the finest-textured leaf provided the climatic conditions are suitable or irrigation is practiced, while it was considered that the Triassic stony loam was less desirable than the other soils. There are no other soils in the Connecticut Valley which it is believed will be adapted to the Sumatra tobacco, except possibly the Podunk fine sandy loam, which has not been tested.

While a large edition of the Connecticut Valley soil map was printed, the demand has been so great that the edition is practically exhausted; but so many have been distributed within the area of the valley that they can easily be consulted.

THE ERECTION AND COST OF THE SHADE.

An attempt was made to keep an accurate record of every expense incurred in the production of the different crops, but this was found to be impracticable, because the whole work was new, every detail had to be worked out, and every emergency had to be met with untrained labor and without any precedents—at least in this part of the country—for similar work. It is impracticable, therefore, to give the exact amount of material used by the several growers or the exact cost of the material. It varied in different places. Some of the growers were able to obtain their posts at a lower price than others; some of them obtained their posts on their own land; some purchased more material than was actually needed, and all of them used their labor for an indefinite time on this and on other farm operations. The average cost of the material used can be given, but the cost of the labor is much more difficult to estimate.

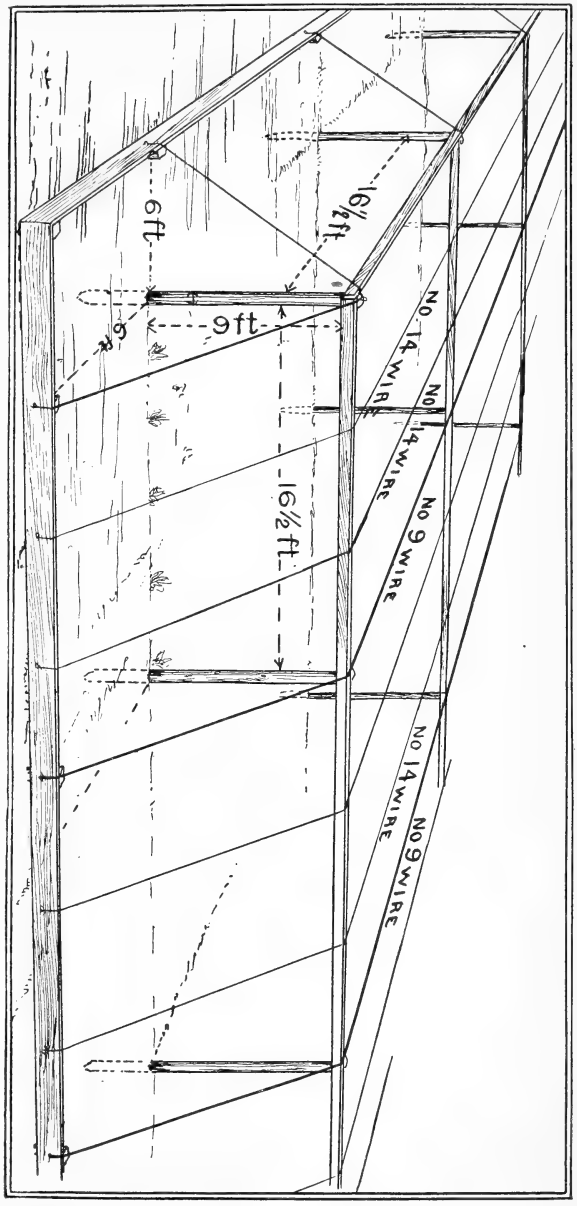

FIG. 1.—Framework of shade, as used in the season of 1901, ready for cloth to be stretched.

In the erection of the shade, posts 12 feet long were set 3 feet in the ground, leaving 9 feet for the height of the frame. These were placed 16½ feet apart and were principally of chestnut 4 inches in diameter, or 4 inches square. These posts were connected one way by stringers 16½ feet long, and across the other way were run heavy cable wires stapled to each post and made secure at each end of the field by stakes driven well into the ground. Parallel with and between these cable wires (No. 9) were run wires of lighter weight (No. 12) to support the cloth. These were placed 5½ feet apart, making two between each cable. The entire shade was surrounded by a baseboard 6 inches wide, made up of 16½-foot lengths, which was set 6 feet from the base of the outer posts and fastened to the stakes driven in the ground to which the ends of the wires were stapled. Along the stringers and the baseboard was also run the lighter-weight wire, around which was wrapped the selvage of the cloth, when it was stapled. Formerly laths were used around the baseboard, but it was observed that these often rotted before the season was over, and the wire was tried with more satisfactory results. The wire on the stringers relieved the strain on the selvage of the cloth. The entire structure was covered with tent cloth, which came to the ground on all sides. This cloth was 5½ yards wide, sufficient to cover the space from one stringer to another. This was run the entire length of the field and brought down to the ground at the two ends. The other two sides were covered with cloth of the same material 126 inches or 144 inches wide. A gate was provided, covered with cloth, and in fields of large dimensions a road was left lengthwise through the field. The details of the construction of the shade as used during the past year are illustrated in fig. 1. The material and approximate cost of the same and the labor are as follows, the estimates being based upon an acre in a rectangular area 165 by 264 feet, or 10 by 16 rods:

Cost of materials and labor for rectangular area 165 by 264 feet.

Materials:	
187 posts (4 by 4 by 12), at 18 cents each	$33.66
196 stringers (2 by 4 by 16½), at $18 per 1,000 feet B. M	38.80
924 feet of baseboard (1 by 8), at $18 per 1,000 feet B. M	11.09
56 stakes (4 by 4 by 4), at 5 cents each	2.80
166 pounds (9,796 feet) No. 14 wire, at $3.60 per 100 pounds	5.98
179 pounds (3,077 feet) No. 9 wire, at $3 per 100 pounds	5.37
16 pounds 8d. nails, at 3 cents per pound	.48
23 pounds 20d. nails, at 2½ cents per pound	.58
10 pounds 1¼-inch staples, at 4 cents per pound	.40
8 pounds ¾-inch staples, at 6 cents per pound	.48
952 yards tent cloth 16½ feet wide, at 17⅓ cents per yard	165.02
187 yards tent cloth 12 feet wide, at 12½ cents per yard	23.38
	288.04
Labor in construction of shade	27.00
Approximate cost of materials and labor	315.04

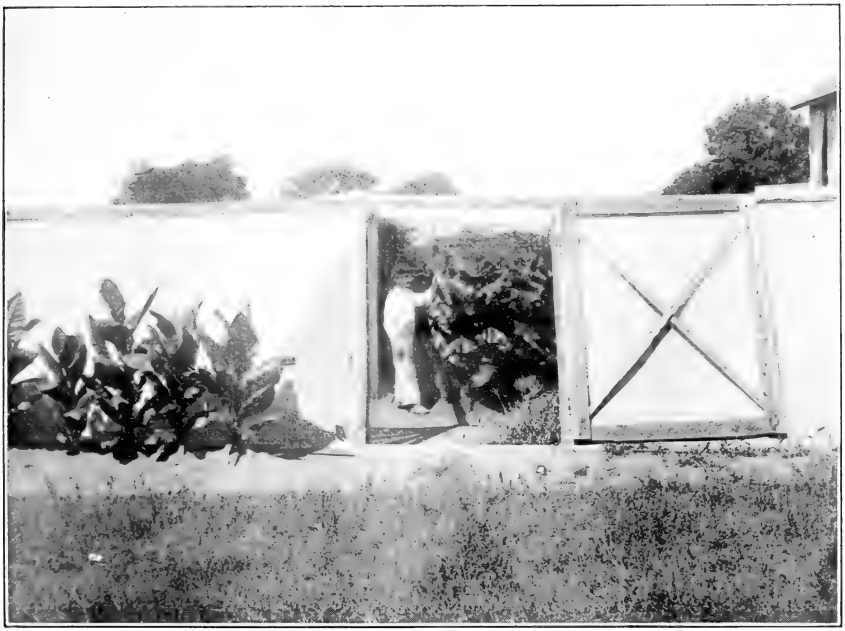

FIG. 1.—VIEW SHOWING THE CONSTRUCTION OF THE GATEWAY, WHICH, IN A LARGE FIELD, IS A DOUBLE GATE THROUGH WHICH A TEAM CAN PASS. IT ALSO SHOWS THE RELATIVE SIZE OF MATURE PLANTS GROWN UNDER SHADE AND GROWN IN THE OPEN FIELD, THE LATTER HAVING BEEN TOPPED IN THE USUAL WAY.

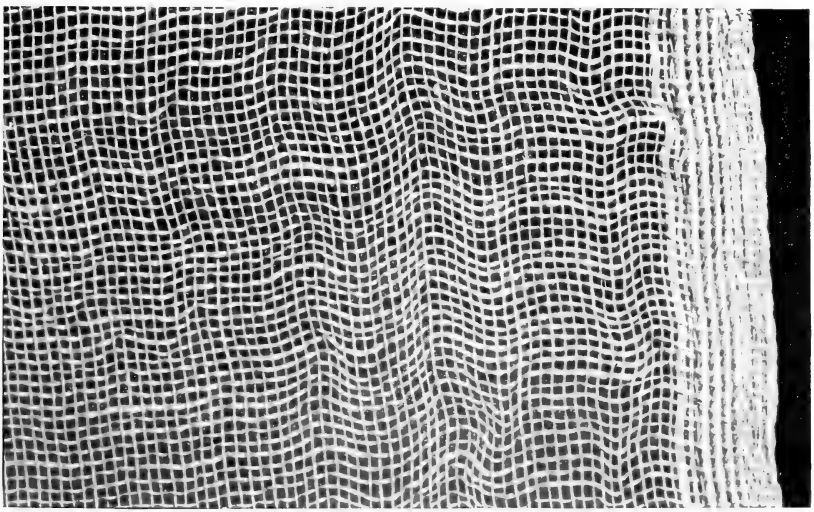

FIG. 2.—PIECE OF TENT CLOTH, ESPECIALLY MADE FOR THE PURPOSE, TO BE USED IN THE SEASON OF 1902 (FULL SIZE), SHOWING THE FOUR CORDS WOVEN IN THE SELVAGE EDGE.

The cloth used during the past season is known to the trade as "GB." It is heavier than cheesecloth, and is much more substantial. In the early part of July the Connecticut Valley was visited by a cyclone of unusual severity. This was preceded by a hailstorm, which did considerable damage to the crops in the open fields, but the cloth entirely prevented damage from the hail to the plants growing within the tents. The wind following this hail was of such force that it overturned buildings and trees, but there was no injury to the crops growing within the tents, as the force of the wind was lessened by the covering and there was no lashing or tearing of the leaves. The cloth was torn in some cases, but the entire damage on the 41 acres under the control of the Department was repaired at an expense of $50 for material and labor. It is not believed that such a severe test will occur again in many years, and it was gratifying to the growers to find that their crops were so perfectly protected.

It was anticipated that the cloth used last year would be suitable for use during a second season, but it was subsequently considered undesirable to try this on a large scale and safer to purchase new cloth for the following year. It is the consensus of opinion that a still heavier grade of cloth could be economically used in future operations, and the cloth manufacturers have produced samples of a heavier thread and with some decided advantages, which it is believed will enable the cloth to be used safely for two seasons. Instead of cloth costing 17⅓ and 16½ cents a yard for the 16½ and 12 foot widths, respectively, it is proposed to substitute a better grade costing 21½ and 16½ cents a yard for the respective widths. The cloth furnished this year also has a selvage edge, carrying 5 cords, which it is believed will materially strengthen the covering. A full-size illustration of this is given in Plate III. In addition to this, there is a strip of closely woven material running across the cloth at every 5 or 6 feet, which it is believed will prevent the cloth from drawing. With this more expensive material the total cost of an acre of shade would be $362.18, as against $315.04 as used during the past year. The framework will last from five to eight years, so that the cost of this should be proportioned out for the crops for a series of years rather than for the crop for the first year.

Various improvements have been suggested in the construction of the shade, some of which it is believed will be very desirable. At the sides of the field, where the cloth is stretched down to the surface of the ground, the distance between the outside post and the baseboard may be 9 feet instead of 6. It is believed that this will give more room for the teams to turn at the end of the rows. The rows are run 3 feet 3 inches apart, and each line of posts will thus come in a row. The cloth manufacturers have devised special looms for weaving cloth of this kind in the unusual width of 288 inches, or 24 feet. It is proposed by some of the planters to use this extra wide cloth and put the posts

20 by 24 feet apart, as shown in figure 2. This width of cloth costs 34 cents per running yard. The additional cost of this extra wide material is made up for, however, in the smaller number of posts and the less quantity of other materials. The actual amount of material and labor required for the construction of a shade for an area of 200 by 216 feet (approximately 1 acre) is about as follows:

Cost of materials and labor for area of 200 by 216 feet.

Materials:	
128 posts (4 by 4 by 12), at 18 cents each	$23.04
36 stringers (2 by 4 by 12), at $18 per 1,000 feet B. M	5.19
100 stringers (2 by 4 by 20), at $18 per 1,000 feet B. M	24.00
880 feet of baseboard (1 by 6), at $18 per 1,000 feet B. M	7.92
60 stakes (4 by 4 by 4), at 5 cents each	3.00
113 pounds (1,944 feet) No. 9 wire, at $3 per 100 pounds	3.39
292 pounds (10,005 feet) No. 12 wire, at $3.05 per 100 pounds	8.91
38 pounds (645 feet) No. 8 wire, at $3 per 100 pounds	1.14
665 yards tent cloth 288 inches wide, at 34 cents per yard	226.10
145 yards tent cloth 144 inches wide, at 16½ cents per yard	23.85
24 pounds 20d. nails, at 2½ cents per pound	.60
20 pounds 8d. nails, at 3 cents per pound	.60
8 pounds ¾-inch staples, at 6 cents per pound	.48
10 pounds 1¼-inch staples, at 4 cents per pound	.40
	333.62
Labor in construction of shade	27.00
Approximate cost of materials and labor	360.62

The cloth is put on in the following way: The selvage edge of two widths is brought together over the stringers and twisted around the wire which runs the length of the stringer, and tacked at frequent intervals with staples. The 12-foot width is stretched on the outside over the last stringer down to the baseboard. Care must be taken to leave no openings for grasshoppers or other insects to gain access to the tent. The baseboard itself should be from 2 to 4 inches in the ground, or earth should be thrown up on the outside to close all openings. The appearance of the tent is shown in several plates.

The material and prices given here for an acre of shade are about an average for the several fields that were cultivated during the past season. It must be understood, however, that it costs less in proportion for an 8-acre field than it does for a small field, and it must be understood also that the material costs more or less, according to the location of the field and the source of the material. For example, the posts used by the different planters this year cost from 10 to 20 cents apiece. Some of them had posts on their places, others had to purchase, and some had to haul them for a greater distance than others. Furthermore, it must be remembered that these quantities are exactly what is required on an acre of the shape referred to. If the field is of irregular shape and has many angles, the amount of material varies

a little. Furthermore, the prices given are about the average values at the present time, and anyone going into the construction of shade must understand that these prices will vary somewhat according to the market. The material used on the 13 farms ranged from $260.03 to $403.64 per acre, the average being about $286.70 per acre.

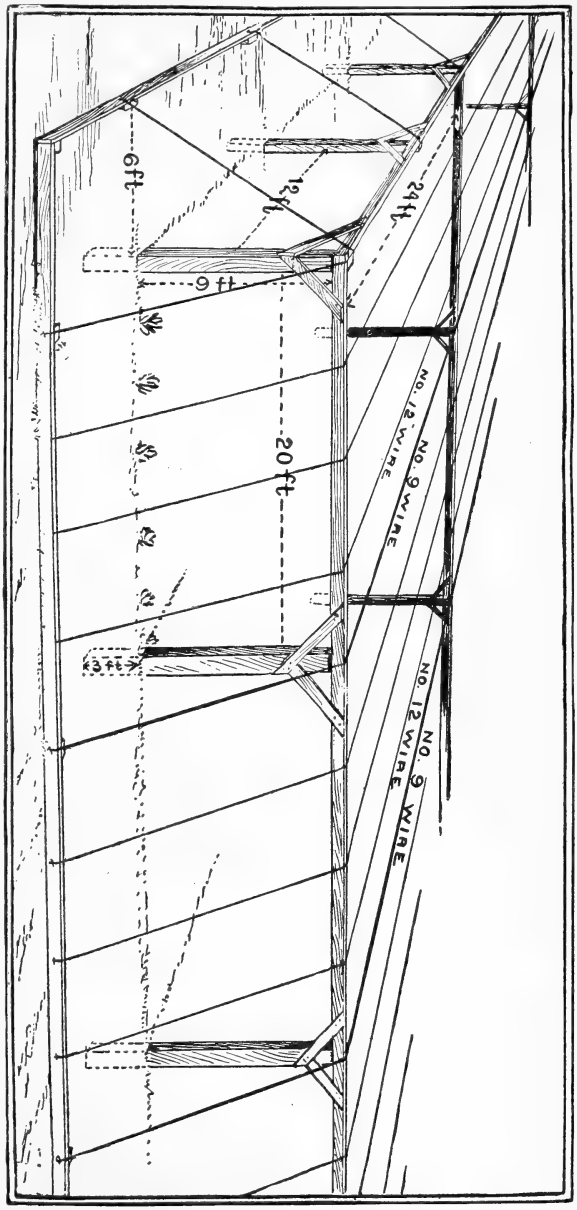

FIG. 2.—Framework of shade, to be used to a limited extent in the season of 1902, with posts 20 by 24 feet apart, arranged for cloth 288 inches wide.

CULTIVATION AND FERTILIZERS.

The ground should be plowed as soon as the frost permits in the spring, and heavily manured to make it as rich as possible. After the manure is applied broadcast, the land should be harrowed with a disk harrow and then with a smoothing harrow. The plants are preferably set with a planter. In drawing the plants it is well to wash all of the soil from the roots, as they seem to do better than if some of the seed-bed soil is left adhering to them. The plants are set at a distance of 12 inches apart, in rows 3 feet 3 inches apart, running with the posts. This gives one row in a line with the posts, which has to be set by hand. With posts 16½ feet apart there will be four rows between each line of posts.

As the machine waters the plants when they are set, the transplanting can be done at any time irrespective of the weather conditions. The use of the machine is better than hand planting, as the plants seem to do better, and less replanting is required. Plants require about five or six days to take root, after which cultivation should be begun and continued rapidly and frequently until they get so large that further cultivation is liable to injure them by tearing the leaves.

In order to insure a rapid growth, the ground should be constantly stirred, and it is well to go over it at least twice a week, either with a hoe or a cultivator. Cultivation will stop about the time the plants begin to button, at which time they will be so large a plow will injure the leaves. Further cultivation should be done only with the hoe, and this used very lightly. At this stage the soil will be so shaded that it will not become baked and hinder the feeding of the surface roots.

The fertilizers used are generally stable manure, cotton-seed meal, cotton-hull ashes, and frequently potash, preferably in the form of carbonate, but often in the form of sulphate. Bone meal is frequently used, and lime occasionally. A safe application of manure is 5 cords horse manure per acre, 1 ton cotton-seed meal, and 500 pounds cotton-hull ashes. Frequently these proportions are varied and some of the other fertilizers used, or complete fertilizers are employed.

Every effort is made, both through fertilizing and cultivation, to maintain a steady and rapid growth, as any check in the rate of growth tends to thicken the leaf and reduce its elasticity. The leaf is also liable to become curly and not as satisfactory for wrapper purposes.

HARVESTING.

Considerable judgment is required in the matter of topping plants. If the plants are thrifty and the weather favorable for growth, it is well not to top the plants at all, but to let them produce their flowers and seed pods. If, however, the plants seem weak and it appears that they can not mature the full number of leaves, they should be topped by pinching out the button, allowing to remain as many leaves as the plant will be able to mature. Suckers should be kept off the plants, so as to throw the strength into the main stalk. In the event of the plant being topped too low, if this is recognized at once by the thickening up or curling of the leaf, some of the top suckers can be permitted to grow out and this will act as a sort of safety valve and keep the leaves of the proper fineness.

With attention to these matters and due consideration of the soil and climatic conditions the leaves can be grown to almost any thickness that is desired, bearing in mind, however, that as a general rule the thicker the leaf the less elasticity it will have and the less perfect will its service be for a wrapper. Where plants are not topped they grow to the full height of the shade and the blossoms often push up the cloth cover at the height of 9 feet from the ground.

FIG. 1.—VIEW OF INTERIOR OF SHADE, SHOWING METHOD OF CONSTRUCTION, THE ROADWAY LEADING THROUGH IT AND PLANTS RECENTLY SET OUT.

FIG. 2.—TOBACCO PLANTS UNDER SHADE, FIVE WEEKS OLD.

The shade-grown tobacco should be primed, i. e., the leaves should be plucked off as they ripen, and this again is a matter which requires great judgment on the part of the farmer. It is more difficult to tell when these shade-grown leaves mature than when grown in the open field. Slight indications are seen in a brownish color around the edges of the leaf and on the tip, and occasional spots are likely to appear at other places on the surface. The ordinary indications of ripeness which govern tobacco grown in the open fields—such as yellow splotches, curling of the leaf, and the snapping of the midrib when pinched—will not apply to shaded tobacco.

It is advisable to harvest the leaf at an early stage of ripeness, as it has more elasticity than if allowed to become quite yellow on the edges and tips. At the same time, there is danger in harvesting too green, as in such cases the leaf has a greenish cast, even after fermentation. By picking off the bottom leaves as they ripen they can be saved and excellent wrappers be made of them, where they would be quite worthless if the crop was cut in the ordinary way. These bottom leaves have not the gloss of the middle leaves, but have a dead color more closely resembling the Cuban type than the Sumatra type, and they are frequently packed in carrots and baled in the Cuban style.

It is usual in the first priming to take off three or four leaves, and then an interval of several days or perhaps a week or ten days will elapse before another priming can be made. By going over the field in this way and picking the leaves as they ripen the leaves are of a uniform degree of ripeness and are of a much more uniform size than when the plant is cut, and this is a very desirable object. The different primings should be kept separate in the barn so that they can be fermented separately, as each set of leaves from different parts of the plant requires different treatment in the bulk. It will be found that even the top leaves make very desirable wrappers that are preferred by some manufacturers for particular markets, while the bottom leaves, usually very light in color and exceedingly thin, are desired by other manufacturers for different lines of goods. The middle leaves make the choice wrappers for the general trade.

As the tobacco is primed or picked off the stalk the leaves should be kept straight, placing them back to face and laying them along the rows in piles of from 10 to 12 leaves each. These piles are put in baskets 18 by 36 by 12 inches deep, lined with burlap, with the butts to the ends of the baskets and the tips to the center. They are transported in these baskets to the curing shed.

In the curing shed 30 to 40 leaves are threaded on a string, each end of which is fastened to a lath and this is immediately hung in the barn for curing. The leaves are placed on the string face to face and back to back, to prevent curling. It is usual to make five or six primings of a crop, which occupies a period of from four to six weeks. A barn

can therefore be used for two or three primings if the curing progresses favorably and the leaves are taken down as soon as they are cured. A stalk of Sumatra tobacco will carry from 20 to 25 leaves.

As soon as the entire crop is harvested the stalks should be cut, and if they are plowed under immediately, while they are green, they will decay readily and be a benefit to the soil as a fertilizer. If, however, the stalks remain in the field until they become hard and woody it is best to take them from the field and cut or grind them and mix them with stable manure, to be used as a fertilizer.

BARN CURING.

The manipulation of the barn or curing shed is governed entirely by the conditions of the weather and the nature of the tobacco, so no fixed rules can be given. However, in a general way it can be said that if a barn be filled with green tobacco, and the weather is hot and dry, the ventilators should be tightly closed for about three days, by which time the tobacco should be quite yellow. The barn should then be opened at night and kept closed during the day. This is done to prevent rapid curing, as rapid curing destroys the life of the leaf and gives uneven colors. If there are frequent showers and but little sunshine, the barn should be closed and fires started in small charcoal heaters, distributed throughout the barn, for a short time each day. These fires should be continued as long as it is necessary to keep the tobacco in proper condition. Where charcoal heaters are not available, wood which has as little odor and as little smoke as possible should be used. It is very important to dry out the barn without giving the tobacco any foreign odors. To obtain the best results the tobacco should become fairly moist and fairly dried out once in every twenty-four hours.

As so much depends on the curing of this tobacco, the question of curing sheds is one that should receive considerable attention. A fine crop in the field is no guarantee that it will be good and merchantable when ready for the market. Many very fine crops of tobacco are ruined on account of poor curing sheds. The tobacco barns in New England as a rule are very unsatisfactory, as they are made very open. In consequence of this it is impossible to control the amount of moisture or heat within the limits required during the process of curing. It was the experience during the past year that the damp air blew through the entire shed during murky weather, although the barns were closed as tightly as was possible. While every endeavor was used to dry the barns out by means of open fires it was found very difficult, because as fast as the air in the barns was dried out the damp air blew in. It is impossible to dry such barns out with charcoal fires, and it was found necessary to use open wood fires. In one barn 30 feet by 100 feet it

was necessary to use 16 such fires, whereas if the barn could have been tightly closed a few charcoal heaters would have been sufficient.

Barn curing seems to be a weak point with the New England farmer. This applies to the outdoor or open field tobacco and with even more force to tobacco grown under shade. It is a fact that an exceedingly fine crop of tobacco was grown in the Connecticut Valley this year, and yet because of poor barns and poor barn management the value of the crop in some instances was reduced 50 per cent on account of pole rot. This can be easily prevented by building barns that can be tightly closed and thoroughly ventilated when necessary. With such construction a few charcoal fires would suffice to dry them out, even though the weather might be murky, and in this way pole sweat, mold, and damage of any kind that arises from excessive moisture can be prevented. The opening and closing of the barn requires great care and intelligence, because it is by the process of allowing the tobacco to become alternately soft and dry that the leaf is properly cured. If the tobacco is allowed to dry out quickly the color will be uneven and mottled and the fiber woody. On the other hand, if the tobacco is allowed an exceedingly long time in curing the leaf will become soggy and tender. Therefore, one should endeavor to so manipulate the barn that the tobacco shall become fairly soft and be fairly dried out once in every twenty-four hours. The opening and closing of the barn will also keep the air fresh and wholesome.

If the season during which the tobacco is being cured is excessively hot and dry, it is well to close the barn tightly during the day and to open it at night. During the day the tobacco will become very dry and at night, with the ventilators open, it will cool off and become soft and pliable. With properly constructed barns and intelligent manipulation there is no reason why tobacco should be lost by such causes as stem rot, pole sweat, or mold.

The barn curing of the tobacco is completed when the midribs of the leaves are cured, at which time the tobacco is ready to be taken to the packing house. To get the tobacco in condition to handle, all the ventilators should be left open for one night, opening them about 6 o'clock in the evening. The next morning the tobacco should be in what is called "good case;" that is, it should have taken up sufficient moisture to have become soft and pliable. The barn should then be tightly closed in order to retain the moisture. After the tobacco has been taken from the laths it should be carried at once to the packing house for fermentation.

The average time for curing tobacco that has been primed is from fourteen to eighteen days. As it is a characteristic of the Sumatra to cure with a greenish tint, a brownish yellow color in the barn curing must not be expected. If, however, the tobacco is taken from the poles in a soft condition—containing from 28 to 30 per cent of

moisture—and transported immediately to the warehouse and put in bulk, the process of fermentation will entirely change this green tint to a rich brown color.

To take the tobacco from the poles or laths the leaves should be pushed to the center of the string, both ends cut, and the string used as a tie. These bundles or hands are then packed in cases and transported to the sweat room, where they are put in bulk. From 5,000 to 6,000 pounds of tobacco should be put in each bulk, as this quantity will generate more heat and the tobacco will ferment better than in a small bulk.

FERMENTATION.

To bulk Sumatra tobacco, a platform 5 feet wide and 12 feet long should be raised about 4 inches from the floor of the sweat room by the use of four skids. At the end of this platform are placed headboards 5 feet wide and 7 feet high. Such a platform will hold from 5,000 to 6,000 pounds of tobacco. After covering the platform and headboards with paper the bulking is begun by laying the two outer rows, placing the heads of the tobacco even with the edges of the platform and allowing the tips to point to the center. Then another row should be begun on each side, allowing the heads to rest two-thirds of the way from the butts, with the tips pointing toward the center. A third row should be made on each side in the same way. This will be sufficient to cover the base of the platform, making six rows across. The second layer should be made in the same manner, and this process should be continued until the bulk has reached a height of 5 or 7 feet, or until 5,000 or 6,000 pounds of tobacco have been bulked. When the bulk is completed the top should be covered with ordinary cotton blankets, and over these rubber blankets should be placed.

The temperature of the room in which the bulking is done should be kept at from 70° to 80° F. If the tobacco contained from 28 to 32 per cent of moisture when bulked and the room is kept at the temperature above named, the tobacco will generate sufficient heat to have a daily rise in temperature of from 5° to 8°. The bulk should be turned or rebulked six or eight days after first being put down. If the tobacco seems to have dried out to any marked degree the room should be kept warm and quite humid during the turning. The rebulking should be done in the following manner:

Fill three or four cases with tobacco from the top of the bulk, and set them aside. The new bulk should then be begun and continued until one-half of the old bulk has been removed. Then put on the new bulk the three or four cases that were set aside and refill these cases with tobacco taken from the center of the old bulk and set them to one side. Continue the new bulk with what remains of the old bulk and on top of this put the tobacco which was set aside in cases. During the entire process of rebulking the outer layers of the old bulk

FIG. 1.—PLANTS GROWN UNDER SHADE APPROACHING MATURITY.

FIG. 2.—TOBACCO UNDER SHADE AFTER SEVERAL PRUNINGS.

should be placed in the center of the new and the center layers to the outside. In this way a complete change has taken place, the top and bottom of the old bulk having become the center of the new.

Although the old bulk may have reached a temperature of 130°, (and it should not be allowed to rise above this), in shaking the tobacco out thoroughly the temperature will fall and will approach the temperature of the room. It will at least fall to 100°; but it will rise quickly, and may reach a temperature as high as that of the first bulk, but a longer time will be required. The second bulk should remain ten or twelve days before rebulking, or until the temperature reaches 120° or 125°, or until it becomes stationary at a lower temperature, when it should be turned and the position of the tobacco changed as above described. The third bulk should be allowed to remain about fifteen days, by which time the tobacco will have warmed up considerably, though it will not reach as high a temperature as in the former bulks. If the tobacco did not contain an overabundance of moisture when first bulked, it will be dried off by this time and the temperature will fall to about 105°. The tobacco will then be thoroughly cured and ready for assorting and baling. If the tobacco is exceedingly moist it is found necessary to turn the bulk more frequently, and the room should be kept warm and dry during the process of turning; otherwise the tobacco will be cured before the moisture is sufficiently dried out, and there is danger of overfermenting.

This method of fermenting removes any possibility of rot or damage, because during the process of rebulking the tobacco is thoroughly shaken out and all objectionable matter that may cause mold or rot is emitted in the air. This is noticeable in the odor which fills the room during the first turning of the bulk. The odor is less objectionable during the second turning, while during the third and fourth turnings the tobacco has attained a mellow, aromatic odor. When this stage is reached the tobacco is safe and there is no further need for fear of damage, and the tobacco could remain in bulk indefinitely without injuring it.

For determining the temperature of the bulks of tobacco during the process of fermentation, the Department of Agriculture has devised an electrical thermometer which has been successfully used in this work. Two or three coils may be placed in the center of each bulk at equal distances from the top and bottom, so that the exact temperature of the bulk may be ascertained.[a]

The following tables show the temperature (in degrees Fahrenheit) of six of the principal bulks of tobacco during fermentation. "A" and "B" refer to the readings of two electrical thermometers located in different parts of each of these bulks.

[a] Bulletin No. 15, Division of Soils: Electrical Instruments for Determining the Moisture, Temperature, and Soluble Salt Content of Soils, by Lyman J. Briggs.

Temperature of bulks during fermentation.

BULK NO. 1, 6,955 POUNDS, MIDDLES AND UPPER MIDDLES.

Date.	A.	B.	Date.	A.	B.	Date.	A.	B.
	° *F.*	° *F.*		° *F.*	° *F.*		° *F.*	° *F.*
Oct. 17	60		Nov. 7	102	116	Nov. 30	100	115
18	70		9	104	126	Dec. 2	104	120
19	76		9[b]			3	104	123
20	90		11	105		4	104	125
21	95		12	106	100	5	104	125
23	110		13	106	102	6[a]		
25	111		14	106	104	11	92	98
28	114		15	106	108	12	94	108
29[a]			18	110	110	13	96	
30	92		19	102	106	16	96	
31	96	133	20[a]			18	98	106
Nov. 1[a]			23	90	95	19	98	108
2	95		25	96	98	21[c]		
4	96	72	26	96	98			
6	100	95	27	98				

[a] Bulk turned. [b] 5,289 pounds turned to bulk No. 2. [c] Bulk turned; completed.

BULK NO. 2, 8,860 POUNDS, MIDDLES AND UPPER MIDDLES.

Date.	A.	B.	Date.	A.	B.	Date.	A.	B.
	° *F.*	° *F.*		° *F.*	° *F.*		° *F.*	° *F.*
Nov. 12	105		Nov. 25	98	120	Dec. 12	100	88
13	106		26	98	120	13	110	95
14	108		27[a]			16	110	108
15	110		30	96	85	18	108	108
16	110		Dec. 2	96	102	21[a]		
16[a]			3	111	108	23	108	116
18	80	99	4	110	110	24	109	118
19	86	108	5	114	112	26	109	119
20	93	110	6	114	112	27	104	120
21	98	118	9	118	112	28	104	120
22	98	119	10[a]			30	104	120
23	100	120	11	96	79	Jan. 1[b]		

[a] Bulk turned. [b] Completed.

BULK NO. 3, 1,201 POUNDS SUMATRA, AND 2,783 POUNDS HAVANA.

Date.	A.	B.	Date.	A.	B.	Date.	A.	B.
	° *F.*	° *F.*		° *F.*	° *F.*		° *F.*	° *F.*
Oct. 17	103	99	Nov. 8	98	109	Nov. 23[a]		
19	120	113	9	101	111	25	100	105
21	127	107	11	101	110	26	108	109
23	122	102	11[a]			27	111	110
23[a]			12	95	91	28	115	110
24	92	104	13	98	95	29	115	110
26	99	109	14	103	105	30	116	111
28	101	111	15	106	108	Dec. 2	115	110
Nov. 1	102	113	18	115	106	3	114	
4	102	112	20	117	101	3[b]		
6	99	109	21	117	103			
7	99	109	22	115	103			

[a] Bulk turned. [b] Completed.

BULK NO. 4, 5,812 POUNDS, SAND LEAVES.

Date.	A.	B.	Date.	A.	B.	Date.	A.	B.
	°F.	°F.		°F.	°F.		°F.	°F.
Sept. 1–3[c]			Sept. 21	114	107	Oct. 2[a]		
5[a]			21[a]			3	100	99
10[a]			22	100	101	4	104	106
11	98	102	23	105	107	5	110	110
12	104	106	24	110	110	6	113	111
13	108	109	25	113	113	7	116	112
14	110	111	26	113	114	8	118	114
15	112	113	27	114	114	9	117	113
16	114	114	28	113	114	10	116	113
17	116	114	29	113	113	11	116	113
18	115	112	30	113	113	12	116	113
19	115	111	Oct. 1	112	113	13	116	113
20	115	109	2	112	112	14[b]		

[a] Bulk turned. [b] Fermentation completed. [c] Bulked.

BULK NO. 5, 6,441 POUNDS, FIRST AND SECOND PRIMING.

Date.	A.	B.	Date.	A.	B.	Date.	A.	B.
	°F.	°F.		°F.	°F.		°F.	°F.
Sept. 17	95		Oct. 5	112	114	Oct. 24	121	124
18	107	104	6	119	118	25	121	124
19	115	112	7	122	121	26	122	125
20	120	119	8	126	123	27	121	123
21	120	128	9	126	123	28	119	122
22	124	132	10	126	123	29	120	124
23	122	132	11	126	124	30[a]		
24	122	135	12	126	124	Nov. 1	111	103
24[a]			13	127	124	2	115	110
25	105	103	14	127	124	3	117	115
26	111	110	15	126	122	4	121	116
27	117	115	16	126	121	5	121	117
28	121	120	17	126	121	6	120	115
29	126	124	18	122	120	7	120	115
30	127	125	18[a]			8	120	115
Oct. 1	127	127	19	102	107	9	116	
2	127	127	20	108	114	11	114	
3	127	127	21	112	118	12	114	
3[a]			22	118	122	13	113	(b)
4	102	104	23	119	123			

[a] Bulk turned. [b] Completed.

BULK NO. 6, 4,058 POUNDS, THIRD AND FOURTH PRIMING.

Date.	A.	B.	Date.	A.	B.	Date.	A.	B.
	° F.	° F.		° F.	° F.		° F.	° F.
Oct. 2	92	.....	Oct. 22	98	100	Nov. 11	.....	111
3	100	.....	23	102	104	12	.....	110
4	108	.....	24	110	110	13	.....	109
5	121	.....	25	114	114	14	110	110
6	126	.....	26	116	114	15	110	110
7	130	.....	27	117	116	16	111	110
8	132	.....	28	118	118	17	110	110
8[a]	.....	.....	29	114	114	18	110	109
9	90	97	30	115	116	19	109	109
10	97	103	31	115	116	20	112	112
11	102	106	Nov. 1	115	117	21	112	112
12	104	108	2	117	115	22	112	111
13	108	113	3	117	114	23	110	109
14	112	115	4	117	113	24	109	109
15	114	115	5	114	111	25	109	107
16	116	116	5[a]	.....	.....	26	108	107
17	116	117	6	92	97	27	107	107
18	116	118	7	104	106	28	107	106
19	118	118	8	107	110	29[b]	.....	.....
20	120	121	9	.....	111			
21[a]	.....	.....	10	.....	.....			

[a] Bulk turned. [b] Fermentation completed.

SIZING AND ASSORTING.

When the tobacco has been thoroughly cured the next steps are to size, assort, and bale it. The sizing is the first work, because as the various lengths of tobacco represent the various characteristics and types of the leaf it has been found much easier and less confusing to assort tobacco of a given length than to assort tobacco of many lengths. Therefore, all the tobacco is first sized, making 9 lengths, from 10 to 22 inches, with a difference of an inch and a half between each.

After this work is completed the assorting or shading is done, making light, medium, and dark unspotted wrappers; light, medium, and dark spotted wrappers, and light and dark broken leaves. With the broken leaves are also placed leaves of uneven color or those which are in any way imperfect. In the first 6 grades of spotted and unspotted wrappers the leaves must be perfect in texture and uniform in color. It will be observed that in each crop of Sumatra tobacco there will be 9 sizes of 8 grades each, making in all 72 classifications.

The tobacco is then tied in "hands" of from 30 to 40 leaves each, according to the size of the tobacco (from 40 to 45 small leaves and from 30 to 35 large leaves constitute a hand). These are tied with bark fiber, which is preferred to a leaf for this purpose, and the tobacco is ready to be baled.

BALING.

The last process through which the tobacco must go is the baling or packing. The Sumatra type is tied in what is known as fan-shaped hands, tightly packed in cases, and allowed to remain five or six days. By this time the tobacco has undergone a slight fermentation, sufficient to assist in evening up the colors. It is then packed in bales 30 inches square and pressed to a thickness of 12 inches—the exact size of the imported bales. Such bales should contain from 150 to 160 pounds. The covering used is matting imported from the island of Sumatra, which can usually be obtained from cigar manufacturers, and over this is put another covering of burlap. The baling box and press used in this packing are shown in Plate VII, fig. 1.

Although the seed planted is Sumatra, we often find a small percentage of the leaf will have more the appearance of the Cuban type. This applies chiefly to the first leaves of the stalk, commonly called sand leaves, which are of a dull color and have little of the real Sumatra gloss. For this reason it is found advisable to pack some bales similar to those in Cuba. These leaves are assorted according to size and made into carrots. To make a carrot, about 60 leaves are tied in an ordinary bundle or hand, and four of these hands are tied together with the bast fiber used in Cuba. The outside leaves are made smooth and wrapped from head to tip with Cuban bast fiber, making a neat bundle of tobacco weighing about 1 pound. Of course the weight depends upon the size and thickness of the leaves. As soon as made these carrots are put in bales of 80 carrots each. The material used for covering this bale is palm bark, imported from the island of Cuba, and when finished these bales have the exact appearance of those made in Cuba. Over this is put burlap to hold the bark in place. This being done, the tobacco is ready for the market.

The care of the tobacco after being baled depends largely upon the condition in which it was packed. If it is thoroughly cured and well dried off it should be stored in a place where it will remain as near dormant as possible, as further fermentation is unnecessary and undesirable. If the tobacco is packed in what is known as "high case" (with considerable moisture), fermentation was not completed and the tobacco should be stored four bales deep in a room in which the temperature is 75° or 80°. The position of the bales should be changed once each week for at least four weeks. Then it should be allowed to stand on end to cool off and to stop fermentation.

A FEW SUGGESTIONS.

It may be well to state that the only value of Sumatra is its wrapper quality, and the grower of this type of tobacco should at all stages of the work bear in mind that he is striving for a leaf suitable for wrap-

ping cigars. Therefore, he should use every precaution to preserve the soundness of the leaf. He should study the plant carefully, so as to determine just when the tobacco is in the condition to be harvested. If it is harvested underripe, the tobacco will be exceedingly green when cured, will have a poor grain, and will be undesirable for a wrapper. On the other hand, if the tobacco is harvested overripe, the fiber will be brittle, the leaf not elastic, and hence not of value as a wrapper. There is, therefore, a particular stage of ripeness at which this tobacco should be harvested, and this knowledge can be gained only by watching the plant and the leaves as they mature.

The handling of ordinary tobacco will not apply to this type. The leaf is delicate and needs to be handled with all possible care in all stages of the work. This great care involves expense, but when it is considered that the tobacco is worth $1 to $2.50 per pound by proper handling, and almost valueless with indifferent handling, it is easy to see that the great care and expenditure of money is justifiable.

As has been before stated in this article, as soon as the tobacco has been cured in the barn it should be transported at once to the packing house where it should be put into bulk for fermentation. This may seem to handicap the small planter; but as the growing and barn-curing of tobacco is one branch of the work and the fermenting, grading, and assorting is another branch of the work—the same as the manufacturing of the cigars is still another branch—it is difficult for each planter to master all these lines. Therefore, with this new method a thorough knowledge in all this work is not expected with each planter, and it seems advisable for the grower of a small crop to make some arrangement with the grower or dealer who is able to handle his tobacco. To take the tobacco from the laths, pack it in cases or bundles, as is ordinarily done, and allow the tobacco to remain thus for any length of time will make the crop valueless. The various stages of work should follow closely upon one another.

RESULTS OF THE EXPERIMENT.

The total cost of the shade on the 13 farms on which the experiments were carried on (the area covered aggregating 41 acres, of which 35.88 acres were Sumatra tobacco and the rest Connecticut Havana), ranged from $260.03 to $403.64 per acre, the former cost being for a large area, while the highest cost was for an area of about a quarter of an acre. The average cost was $286.70. This includes the cost of the material, such as lumber, hardware, and cloth, and the labor of putting these together.

These estimates are based upon the actual amount of materials used, and, so far as possible, the actual price paid for the material, but it does not include an excessive amount of material purchased by some of the growers and not used in the actual construction of their shade.

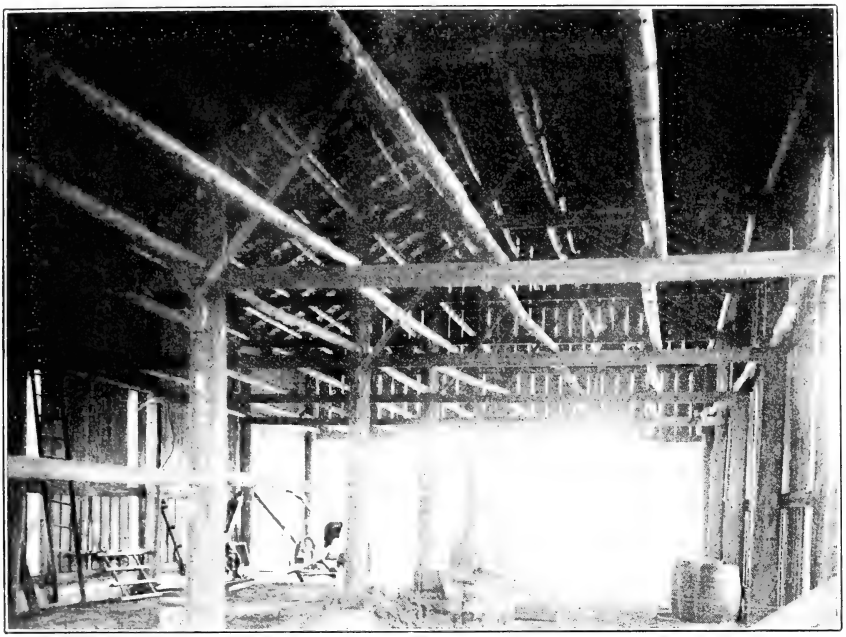

FIG. 1.—VIEW OF THE INSIDE OF A TOBACCO BARN, SHOWING THE SPACES BETWEEN THE BOARDS, THROUGH WHICH THE RAIN AND MIST DRIFT IN, WHICH MAKES IT DIFFICULT TO PREVENT POLE ROT WHEN CURING IN DAMP SEASONS.

FIG. 2.—VIEW IN THE CURING SHED, SHOWING THE METHOD OF STRINGING THE LEAVES, THE WAY THEY ARE ATTACHED TO THE LATH, AND THE BASKETS IN WHICH THE LEAVES ARE TRANSPORTED FROM THE FIELD.

The cost of fertilizers ranged from $10.51 to $64 per acre, the average being $45.31.

The cost of cultivation is estimated at between $34.21 and $73.28 per acre, with an average of $47.94. This includes the preparation of the seed bed, or the purchase of the plants where no seed bed was constructed. This estimate it is believed approximates as closely to the facts as possible, but it is a difficult matter always to give the actual cost of cultivation where farm labor is used for a portion of the time on other parts of the farm.

The cost of harvesting, including the priming, stringing, hanging, and taking down and tying the tobacco is estimated to have ranged from $108.48 to $283.20 per acre, with an average of $137.93. These estimates also are not exact, as labor was used for intervals on this and other work.

The warehouse work, including the fermentation, sizing, assorting, and baling, is estimated to have cost from $111.12 to $179.52, or an average of $139.29 per acre.

The total cost of the crop, including the shade, fertilizers, cultivation, harvesting, and warehouse work, as near as this could be determined from the accounts kept by the farmers and by the Department agents, varied from $613.42 to $849.55 per acre, or an average of $657.17.

The following table gives the acreage grown by each of the 13 farmers cooperating in this experiment, the yield per acre, the total yield of cured tobacco, the total yield after fermentation, and the per cent of loss in fermenting and baling the crop:

Acreage and yield of cured and fermented Sumatra tobacco.

Name.	Place.	Area.	Cured tobacco.		After fermentation.	
			Yield per acre.	Total yield.	Total weight.	Loss.
		Acres.	*Pounds*	*Pounds.*	*Pounds.*	*Per ct.*
H. Woodford	Avon, Conn	4.51	1,250	5,636	.....	.....
C. O. Gates	Pine Meadow, Conn	1.02	1,571	1,616	2,717	8.0
Jas. Stewart	do	.80	1,677	1,337		
E. C. Hills	Southwick, Mass	.25	1,768	442	331	25.1
H. L. Miller	do	.23	1,764	397	268	32.4
H. H. Wright	Mapleton, Conn	.50	1,116	558	486	12.9
Clark Bros	Poquonock, Conn	1.09	1,528	1,635	1,522	6.9
Wm. Hayes	Tariffville, Conn	1.09	1,416	1,543	1,358	12.0
August Pouleur	Windsor, Conn	.74	1,700	1,265	1,079	14.6
L. M. Case	Barkhamsted, Conn	1.56	1,665	2,613	2,236	14.4
W. S. Pinney	Suffield, Conn	6.44	1,237	7,968	6,613	17.0
R. H. Reed	Tariffville, Conn	1.24	1,925	2,245	1,953	13.0
Ariel Mitchelson	do	16.41	1,416	24,053	21,648	10.0
Total and average		35.88	1,430	51,308	40,211	12.0

The total yield on 35.88 acres of Sumatra tobacco was 51,308 pounds, or an average of 1,430 pounds of cured tobacco per acre. The total yield after fermentation was 40,211 pounds, exclusive of the Woodford crop, and the average loss in fermentation was 12 per cent.

The following table shows the weight of the grades of tobacco produced:

Weights of grades of Sumatra tobacco.

	Light wrappers.	Medium wrappers.	Dark wrappers.	Light spotted wrappers.	Dark spotted wrappers.	Cuban packages.	Light seconds.	Dark seconds.	Trash.	Total.
Total weights[a] lbs.	8,038	5,883	1,189	3,051	2,325	8,287	3,128	3,083	5,127	40,211
Per cent	20.0	14.6	2.09	7.6	5.8	20.7	7.8	7.8	12.8	100.00

[a] Not including Woodford crop.

From these records it will be seen that about 71 per cent of the crop was wrappers, 16 per cent seconds, and 13 per cent trash.

The wrappers are graded as light, medium, dark, light spotted, dark spotted, and Cuban packages. The seconds consist of broken and torn leaves and leaves of uneven color, from which considerable amount of wrapper leaf can be obtained. The trash contains some leaf that could be used for filler, but it is generally undesirable for this or any other purpose.

The wrappers are all perfect leaves, without tear or puncture, and the color and grain are sufficiently uniform, and the veins are sufficiently small to allow the entire side of the leaf to be used for wrapping cigars. The leaves average between 225 and 250 per pound. They are graded according to size, with differences of 1½ inches in length between the grades, and the length of the leaf is marked on the package. This is a distinct advantage to the manufacturer, for with leaves of uniform length and uniform color a very close estimate can be made as to how many cigars of given length can be covered and as to what length of leaf can be most economically purchased for a cigar of given size. The uniformity in color also makes it an easy matter to obtain a uniform line of cigars.

The Woodford crop of 5,636 pounds of cured tobacco is not included in this table, as the grading and packing of this crop have not been finished.

In addition to the 35.88 acres of Sumatra tobacco, there were 4.71 acres of Havana seed grown under shade. The total yield was 6,439 pounds, or an average of 1,367 pounds per acre.

COST OF THE TOBACCO.

It is estimated that the cost of the Sumatra tobacco, barn-cured, and including the whole cost of the shade, fertilizers, cultivation, and

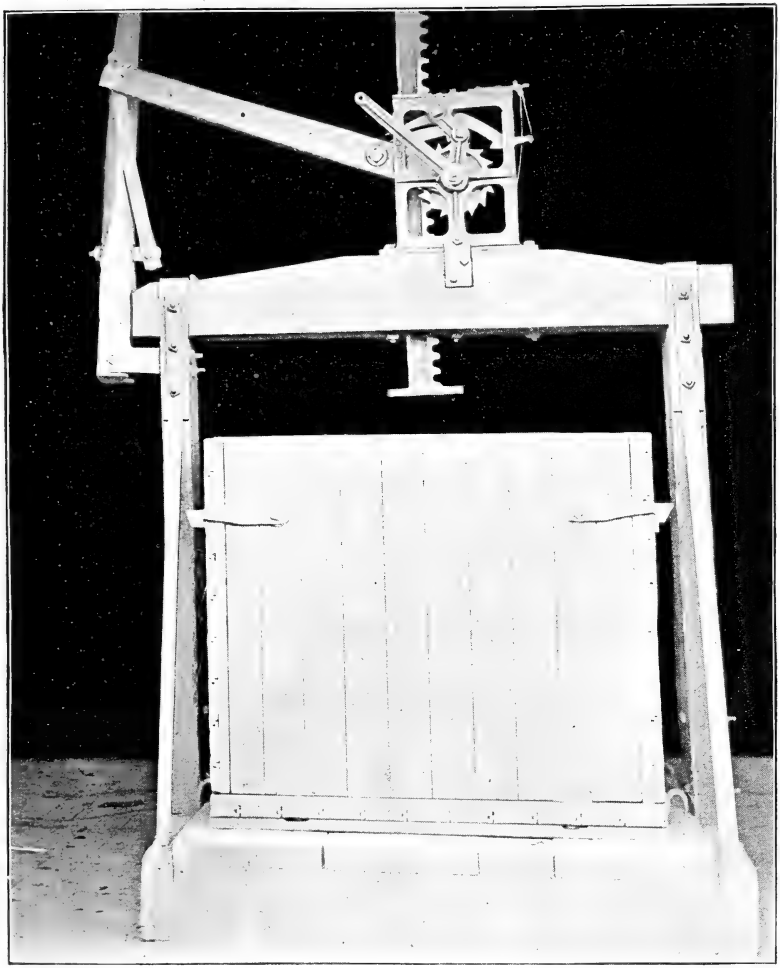

FIG. 1.—FORM OF PRESS FOR MAKING THE SUMATRA FORM OF BALE.

FIG. 2.—FORM OF SUMATRA PACKAGE WITH MATTING INSIDE AND A COVER OF BURLAP.

harvesting, was a little over 36 cents per pound. It must be understood, however, that the framework of the shade is expected to last from five to eight years. If it is assumed that it will last five years and that the cloth will have to be renewed each year, then charging one-fifth only of the cost of the framework the cost of the tobacco this year, barn-cured, would be about 32.2 cents per pound.

The cost of the finished product, including the cost of warehouse work and allowing for the loss in this stage of the work, is estimated at 51½ cents per pound, including the total cost of the shade, or 47.6 cents per pound, charging one-fifth only of the cost of the framework. It is understood that these estimates do not include any charge for land, buildings, or insurance, or interest on the money invested.

SALE OF THE TOBACCO.

As already stated, the Secretary of Agriculture has invited a number of prominent tobacco brokers to advise about the sale of the product, and they have recommended that the sale shall take place about May 1, when all of the tobacco will be ready for market. The terms of the sale will be announced later and the prices obtained for the tobacco will be announced through the public press.

This bulletin is published before the sale actually takes place on account of the great interest that is taken in the work and the recognized desire of those contemplating taking up the business to have information regarding the methods and cost of raising the tobacco and the yields that have been obtained.

Samples of the tobacco have been submitted to leaf dealers, brokers, and cigar manufacturers, and have received very general commendation, the opinion being that it is equal to the imported Sumatra leaf as to style, color, texture, grain, and number of cigars it will wrap per pound. It has not the bitter taste that Sumatra so frequently has. While it is exceedingly thin, it is strong and exceedingly elastic.

Dr. Jenkins, Director of the Connecticut Experiment Station, has reported in Bulletin No. 137 of that station that a portion of the shade-grown leaf raised at Poquonock during the summer of 1901 has been sold at an average price of $1.91 per pound, the prices ranging from $1.40 to $2.50 per pound.

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RECENT PUBLICATIONS OF THE DEPARTMENT ON TOBACCO.

Bulletin No. 11, Division of Soils.—Tobacco Soils of the United States, a Preliminary Report upon the Soils of the Principal Tobacco Districts, by Milton Whitney, Chief of Division of Soils.

Farmers' Bulletin No. 60.—Methods of Curing Tobacco (revised edition), by Milton Whitney, Chief of Division of Soils.

Farmers' Bulletin No. 82.—The Culture of Tobacco, by Otto Carl Butterweck.

Farmers' Bulletin No. 83.—Tobacco Soils, by Milton Whitney, Chief of Division of Soils.

Report No. 58.—Cultivation of Tobacco in Sumatra, by Emile Mulder.

Report No. 59.—Curing and Fermentation of Cigar-leaf Tobacco, by Dr. Oscar Loew, of the Division of Vegetable Physiology and Pathology.

Report No. 60.—Temperature Changes in Fermenting Piles of Cigar-leaf Tobacco, by Milton Whitney and Thomas H. Means, of the Division of Soils.

Report No. 62.—Cultivation of Cigar-leaf Tobacco in Florida, by Marcus L. Floyd, of the Division of Soils, in cooperation with the Division of Vegetable Physiology and Pathology.

Report No. 63.—The Work of the Agricultural Experiment Stations on Tobacco.

Report No. 65.—Physiological Studies of Connecticut Leaf Tobacco.

Reprint.—Growth of the Tobacco Industry, by Milton Whitney and Marcus L. Floyd, of the Division of Soils, in cooperation with the Division of Vegetable Physiology and Pathology. Yearbook, 1899.

Reprint.—The World's Exhibit of Leaf Tobacco at the Paris Exposition of 1900, by Marcus L. Floyd. Yearbook, 1900.